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A NEW GENUS AND TWO NEW SPECIES OF SUBTERRANEAN AMPHIPOD CRUSTACEANS (GAMMARIDAE) FROM NORTHERN MÉXICO

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Although a number of blind, depigmented amphipod crustaceans have been recorded from subterranean waters of the Caribbean Region (Holsinger and Peck, 1968), only one, *Bogidiella tabascensis* Villalobos (1960) (family Bogidiellidae), from Gruta del Cocona, Tabasco, was previously known from México, or, for that matter, from any of the Central American mainland. The only other truly freshwater amphipod known from that country was the ubiquitous *Hyalella azteca* (Suassure) (family Hyalellidae). The latter is widely distributed over North America, and ranges through Central and South America as far south as southern Argentina.

Holsinger and Peck (1968) summarized information on interstitial and cavernicolous amphipods from the Caribbean Region, pointing out the general dearth of information on the subterranean fauna of that vast area, and suggesting that additional exploration would doubtless result in significant future discoveries. Collection of tiny, blind, depigmented amphipods from small groundwater outlets of the Bolsón de Cuatro Ciénegas, Central Coahuila, northern México, bears out their prediction. In August 1968, Gerald A. Cole, W. L. Minckley and sons, Dwight W. Taylor, and J. Jerry Landye obtained more than 40 specimens, which, when studied, were found to represent the new genus and two new species described herein. In

addition to the unique new genus, this discovery also marks the first record of the family Gammaridae from the fresh waters of México, and as noted before is the second record of a subterranean amphipod from that country.

It should be noted that during the past several years members of the Mexican Association for Cave Studies have carefully searched many habitats in the limestone terranes of México for amphipod crustaceans, to no avail (J. R. Reddell, personal communication). In view of the over-all interest, competence, and experience of this association, it seems doubtful if such animals have been overlooked. However, the occurrence of the undescribed genus in tiny seepages and springs, rather than in caves, may offer a clue to the more specific biotopes at present occupied by subterranean faunas of this area.

Descriptions of the new genus and the first of the two new species were prepared by both of us, that for the second of the two new species by Holsinger alone; the remainder of the paper is the work of both authors.

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Mexiweckelia Holsinger and Minckley new genus

Diagnosis: Without eyes or pigmentation; size small; known only from groundwater-related habitats. Antenna 1 longer than antenna 2; accessory flagellum greatly reduced to single segment, or vestigial. Peduncular segment 4 of antenna 2 with several marginal spines; gland cone rather small, not prominent. Interantennal lobe distinct, rounded anteriorly. Upper lip symmetrical, rounded apically. Mandible with well-developed incisor, lacinia mobilis, and molar; spine row with several prominent spines; palp lacking. Maxilla 1 with inner plate rather broad and bearing numerous marginal setae; outer plate with 7 to 9 serrated spines apically; palp 2-segmented, bearing spines or

thickened setae apically. Maxilla 2 with inner plate broader than outer, bearing row of long, obliquely-placed setae; apex of both inner and outer plates bearing numerous coarse setae. Inner plate of maxilliped subrectangular, with thick spines and setae apically and several plumose setae on inner margin; outer plate extending well beyond segment 1 of palp, armed with several blunt-tipped spines and few setae on inner margin; palp well developed, 4-segmented, segment 2 longest. Lower lip with well-developed outer lobes, long lateral processes, and vestigial inner lobes.

Gnathopod 1 with propod proportionately rather small, palmar margin armed with distally unnotched, peglike, spine teeth. Gnathopod 2 with propod proportionately larger than that of first gnathopod; propod palmar margin with double row of distally unnotched, peglike, spine teeth. Pereopods 3 and 4 about equal-sized, coxal plate of pereopod 4 not expanded. Pereopod 7 longest, at least half length of body, longer than pereopod 6 and significantly longer than pereopod 5. Coxal gills well developed, biarticulate, attached by distinct pedicels. Sternal processes absent. Brood plates small and narrow in sexually mature females.

Abdominal sideplates with posterior margins slightly convex, with at least 1 seta each; posterior corners tiny, rounded. Pleopods graduated in length, shorter posteriorly; inner rami slightly longer than outer; peduncles with coupling hooks on inner, distal margins. Uropods 1 and 2 unmodified. Uronites not fused, with 2 or more dorsolateral spines each. Uropod 3 biramous, rami well developed, outer without a second segment. Telson deeply cleft, but not to base.

Gender is feminine. The type species is *Mexiweckelia colei* Holsinger and Minckley new species.

Etymology: The generic name is derived by combination of "*Mexi*," which alludes to the geographic placement of the genus, and "*Weckelia*," the name of a related, Greater Antillean genus.

Affinities: Although *Mexiweckelia* is rather unique in the extreme reduction of the accessory flagellum of antenna 1, and in loss of its mandibular palp, its combined characters indicate a definite relationship with the *Hadzia* group of the family Gammaridae. This group was originally proposed by Ruffo (1956a) to include a small cluster of genera that demonstrated an unusual, circumtropical distribution (*Weckelia*, *Quadrivisio*, *Psammoniphargus*, *Hadzia*, and *Metaniphargus*). Stock and Nijssen (1965) synonymized *Metaniphargus* with *Hadzia*, discussed affinities of some genera of the *Hadzia* group, and pointed out the close similarities between another genus, *Eriopisa*, and *Hadzia*. On the basis of the last comparisons it is evident that *Eriopisa* should also be assigned to the *Hadzia* group. Two more genera, *Paraweckelia* and *Alloweckelia*, were added by Holsinger and Peck (1968), and with the present addition of *Mexiweckelia* the group is expanded to include eight genera, of which almost all are anopthalmous and inhabit interstitial or subterranean biotopes. Five of the eight are known exclusively from freshwaters, while

TABLE 1. Summary of diagnostic characters of *Mexiweckelia* new genus.

Structures	Diagnostic features
Accessory flagellum of antenna 1	Vestigial to 1-segmented
Gland cone of antenna 2	comparatively small
Maximum number of setae on inner plate of maxilla 1	7
Number of spines on outer plate of maxilla 1	7 to 9
Inner plate of maxilla 2	oblique row of 10 to 11 setae
Mandibular palp	absent
Molar seta	present on right, absent from left
Coxal plate of pereopod 4	not broadly expanded
Coxal gills	with pedicels
Outer ramus of uropod 3	1-segmented
Inner ramus of uropod 3	nearly as long (or as long) as outer
Apical margin of telson	cleft ⅔ or more to base
Number of spines per apical lobe of telson	3

the other three occur in marine, brackish, and fresh waters, but predominate in brackish habitats.

Both the reduction of the accessory flagellum of antenna 1 and the total loss of the mandibular palp in *Mexiweckelia* probably are secondary. Reduction to a single, tiny segment is found in the palps of *Weckelia* from Cuba (Shoemaker, 1942), and in *Psammoniphargus* from the Island of Reunion (Ruffo, 1956b). The number of accessory flagellar segments varies from 2 to 6 among other genera of the *Hadzia* group. In *Psammoniphargus*, for example, the biarticulate accessory flagellum is reduced to the point of having its second segment only rudimentary (Ruffo, 1956b). It therefore is not surprising to find this structure reduced to a stub in one species of *Mexiweckelia*, and to a simple segment in the other species.

A summary of diagnostic characteristics of *Mexiweckelia* is provided in Table 1, which may be compared to a similar table published by Holsinger and Peck (1968) to facilitate a critical evaluation of the new genus relative to the other, known Caribbean genera (*Weckelia*, *Paraweckelia*, *Alloweckelia*, and *Metaniphargus* [= *Hadzia*]). *Mexiweckelia* appears more similar, morphologically, to the generic complex composed of *Weckelia*, *Paraweckelia*, and *Alloweckelia*, than to *Hadzia*. Similarities in ecology, and perhaps geographic proximity, also tend to indicate this relationship. *Weckelia*, *Paraweckelia*, and *Alloweckelia* occupy subterranean, freshwater habitats of the Greater Antillean islands of Cuba and Puerto Rico, with the nearest known occurrence approximately 1,900 kilometers (km) east of the presently known range of *Mexiweckelia*

(*Weckelia*, in Modesta Cave, Pinar del Río Province, Cuba). *Hadzia*, represented by two species in the Caribbean, is predominately found in brackish water, interstitial habitats of the Lesser Antilles. *Hadzia curasavicus* (Stephensen) from the Island of Curaçao is the species geographically nearest to *Mexiweckelia*, about 3,700 km east-southeast.

Crustaceans, molluscs, and fishes have been relatively well studied in the Cuatro Ciénegas region. Numbers of families, genera, and known species of these groups, with the approximate percentages of endemism of some categories given in parentheses, are respectively as follows: molluscs—7, 22(27), and 34(50); crustaceans—7, 8(50), and 10(60); and fishes—8, 13(0), and 18(50). "Criteria based on 'degrees of difference' in all the groups presently produce a mosaic of indicated differentiation. Multiple invasions of the area, with differing time regimes resulting in varied differentiation, are clearly indicated [Minckley, 1969]."

Mexiweckelia belongs to a component of the Cuatro Ciénegas biota which must date from considerable antiquity. Its relationships to the Caribbean are roughly paralleled by the cirolanids (Rioja, 1953; Bowman, 1964; Cole and Minckley, 1966, 1970), which enjoy a much wider distribution, however, along the margins of the Gulf Coastal Plain, just inland from areas of mid-Tertiary inundations by the sea (West, 1964). A number of the molluscs show similar affinities, particularly the hydrobiid tribe Cochliopini (Taylor, 1966), and the hydrobiid genus *Pyrogophorus*, which was only recently discovered in fossil deposits of eastern Coahuila (Taylor, unpublished). Cirolanid isopods, at least, are thought to have produced freshwater, cavernicolous populations from marine forms relicted by marine regressions (Bowman, 1964), and the same is true for some other groups. The Cuatro Ciénegas area has not been inundated by the sea since late Cretaceous, or earlier Tertiary (Minckley, 1969), although parts of Coahuila were certainly flooded by shallow seas until early Tertiary times (Weidie and Murray, 1967), so that a tremendous time span is available for formation and persistence of aquatic habitats in that region. "Protection" of the area by a deep-lying Paleozoic mass, called the "Coahuilan Peninsula" (Murray, 1961, and references cited), seemingly minimized the influence of regional orogenies, after the Laramide Revolution and Tertiary deformations were terminated.

Affinities of some of the Cuatro Ciénegas fauna to biotas of the peri-Mediterranean region, in addition to those obviously demonstrated by the *Hadzia* group of Gammaridae, must also be mentioned. This is seen in the occurrence of an undescribed asellid genus of the subfamily Stenasellinae (Minckley, 1969; Cole and Minckley, unpublished), which is otherwise known from Europe, Turkamenia, and tropical Africa (Birstein, 1964; Magniez, 1966a–b, Straskraba, 1967; and others). Similar affinities may also occur in the isopod genus *Asellus* of eastern North America (Racovitza, 1920), which now is known to range south to the Puebla Plateau of México (Cole and Minckley, 1968), in cirolanid

isopods (Bowman, 1964, 1966), perhaps in some inland sphaeromatid isopods (Vandel, 1964; Cole and Minckley, unpublished), and quite obviously in the recent discovery of the Old World crustacean order Thermosbaenacea in southern Texas (Maguire, 1964, 1965). Parallelisms also exist in the tribe Horatiini of the molluscan family Hydrobiidae, again involving subterranean or groundwater-related forms (Taylor, 1966, and unpublished).

Mexiweckelia colei Holsinger and Minckley new species
(Figs. 1–3)

Material examined: Distances are from the center of the village of Cuatro Ciénegas de Carranza, Coahuila, México (Fig. 4). Place names here and in text are from the gazetteer of localities published by Minckley (1969) whenever possible, and alternative names that are used locally are provided in parentheses when appropriate.

Holotype and 15 paratopotypes: unnamed spring-pool, 8.84 km south and 3.96 km west, *ca.* 150 meters (m) west of *bajada* (talus slope) from Sierra de San Marcos, 19 August 1968, G. A. Cole. Additional paratypes: Churince (Laguna Churince, Posos Bonitos), 14.73 km south and 7.05 km west, 12 August 1968, Cole, D. W. Taylor, and J. J. Landye; unnamed, small *laguna* (spring-fed pond), 7.92 km west and 9.42 km south, 19 August 1968, Cole, W. L. and R. K. Minckley; unnamed spring 8.15 km south and 2.29 km west, 15 August 1968, Cole, R. L. and R. K. Minckley; unnamed seep in raised marsh at north tip of Sierra de San Marcos, 7.45 km south and 5.50 km west, 10 August 1968, Cole, W. L., R. L., and R. K. Minckley; and, unnamed, small spring in raised marsh at north tip of Sierra de San Marcos, 7.45 km south and 5.42 km west, 12 August 1968, Cole. The holotype and paratopotypes are deposited at the Smithsonian Institution. Additional paratypes are to be placed in the National Museum of Canada, the Museo Civico de Storia Naturale, Verona, Italy, the Coleccíon de Mexico, México, D. F., and the collections of the authors.

Diagnosis: A tiny, interstitial species, distinguished by a vestigial accessory flagellum on the first antenna, and the expanded and finely-haired posterior margins of segments 4, 5, and 6 of the first gnathopod, and of segment 5 of the second gnathopod. Largest male, 3.5 millimeters (mm); largest female, 3.8 mm.

Description: Male. Antenna 1 about 50 percent length of body, about 45 percent longer than antenna 2; peduncular segments 1–3 progressively smaller, with few setae and no spines; primary flagellum with up to 17 segments; accessory flagellum tiny rudiment or vestige; slender calceoli on many primary flagellar segments. Antenna 2 with peduncular segment 4 slightly broader and longer than 5, with several marginal spines; flagellum with up to 8 segments. Mandibular palp totally absent, mandible otherwise well developed; seta present on right molar, absent on left; spine row with 2 or 3 long, plumose spines. Maxilla 1, left and right differing in structure of palp: right with palp

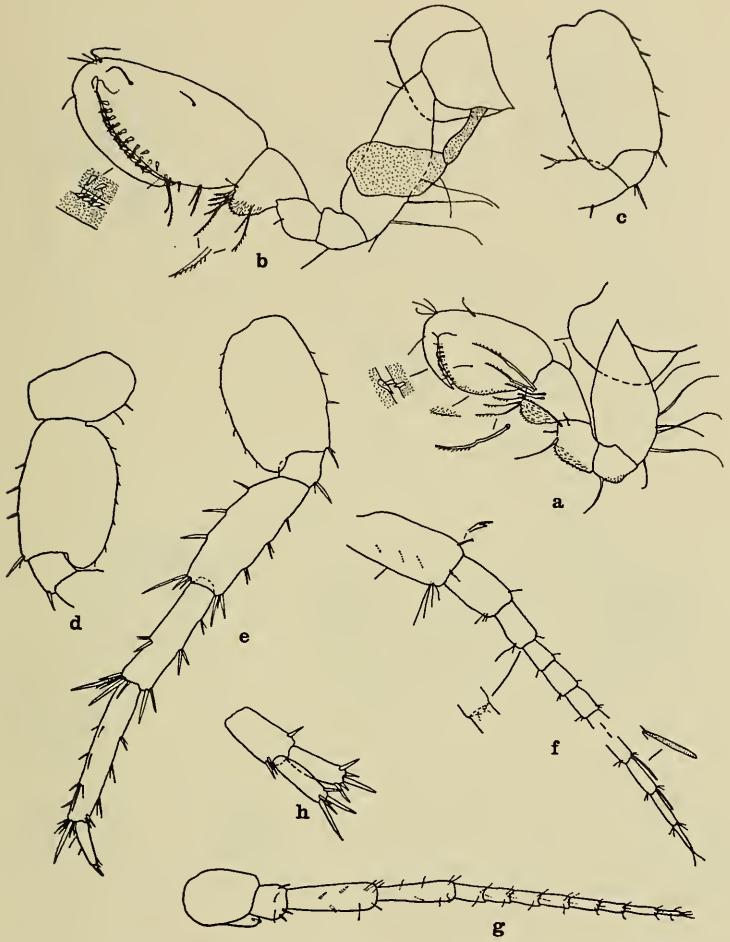

FIG. 1. *Mexiweckelia colei* new species. Male paratype (3.00 mm): a, b, gnathopod 1, 2; c, d, bases of pereopods 6, 7; e, pereopod 7; f, g, antennae 1, 2; h, uropod 2.

distally expanded and bearing 5 or 6 thick spines apically, outer plate with 7 unequal, serrated, apical spines, inner plate with 6 plumose setae on oblique, inner margin; left maxilla with palp scarcely expanded distally and bearing 4 coarse, apical setae. Maxilla 2 with inner plate longer than broad, with oblique row of 10 long setae on inner margin, and 10 or more long, distal setae. Maxilliped with palpal segment 2 longest, about twice as

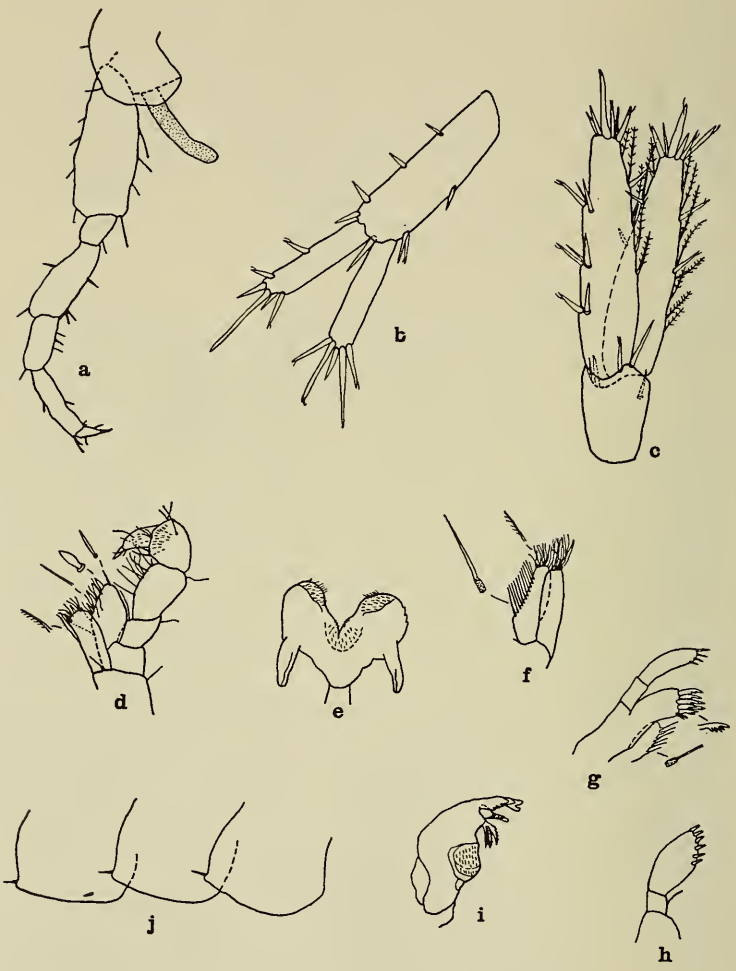

FIG. 2. *Mexiweckelia colei* new species. Female paratype (3.00 mm): a, pereopod 4; b, uropod 1; c, uropod 3. Male paratype (3.00 mm): d, maxilliped; e, lower lip; f, maxilla 2; g, left maxilla 1; h, palp of right maxilla 1; i, left mandible; j, abdominal sideplates.

long as first segment; outer plate expanded medially, extending beyond first segment of palp, bearing 3 or 4 thick, blunt-tipped spines, and several, sub-apical setae; inner plate subrectangular, with 3 or 4 thick spines and several thick setae apically, and 2 long, plumose setae

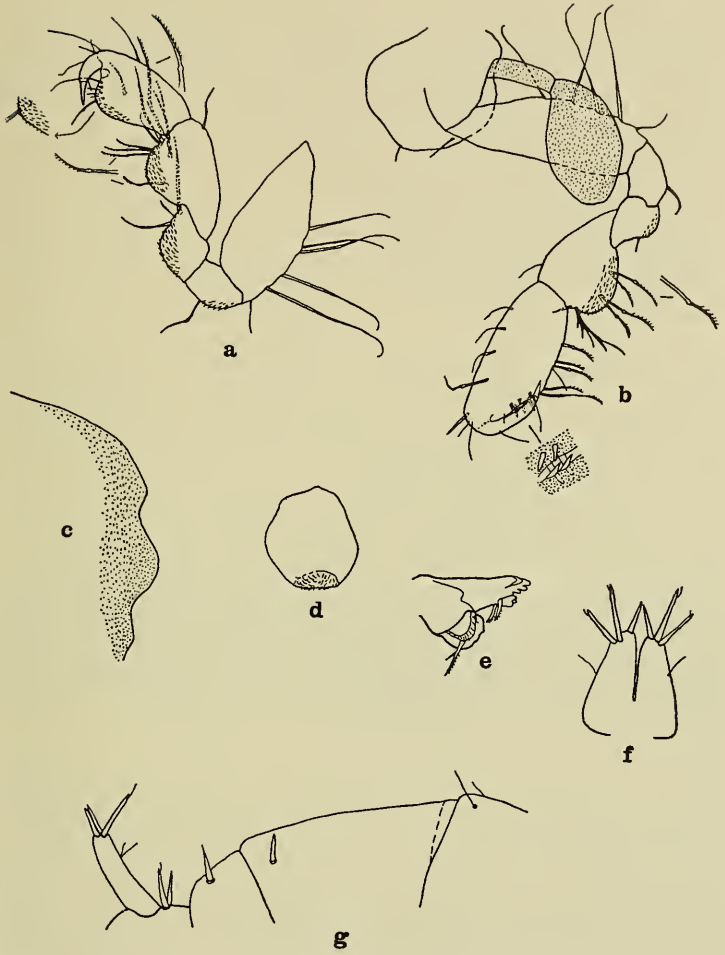

FIG. 3. *Mexiweckelia colei* new species. Female paratype (3.00 mm): a, b, gnathopods 1, 2; c, anterior margin of head; d, upper lip; e, right mandible; f, telson; g, upper urosomal region.

on inner margin. Lower lip with outer lobes narrowing apically to long, narrow, lateral processes; inner lobes indistinct, vestigial.

Gnathopod 1 with propod rather broad, palmar margin slightly convex, armed with double row of unnotched, or unevenly notched, spine teeth; posterior angle indistinct, rounded and unarmed; posterior margin long, convex, covered with very short, hairlike setae; lateral setae few in

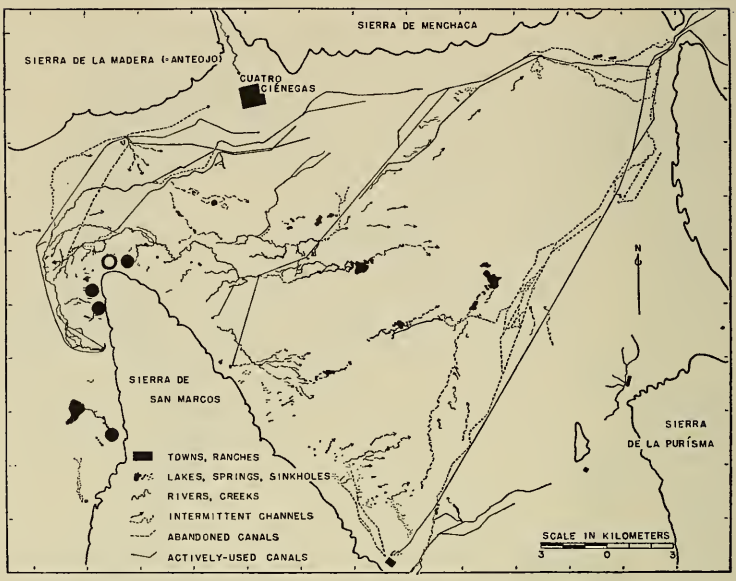

Fig. 4. Drainage map of the Bolsón of Cuatro Ciénegas (from Minckley, 1969, p. 50) showing the distribution of *Mexiweckelia*. Solid circles show localities for *M. colei* (some circles cover two localities) and the open circle shows sympatric locality for *M. colei* and *M. particeps*. The solid circle farthest east marks the type locality for *M. colei*.

number; dactyl with several bladelike spines on inner margin; dactyl nail moderately long. Combined lengths of segments 4 and 5 of first gnathopod equal to length of propod; posterior margins of segments 4 and 5 (especially 5) swollen and covered with numerous, short, hairlike setae. Coxal plate of gnathopod 1 subquadrate, with 1 marginal seta. Propod of gnathopod 2 proportionately larger than first, palmar margin rather long, nearly straight, armed with double row of 8, unnotched, peglike spine teeth; posterior angle with 2 long setae and 1 small spine; posterior margin with 1 set of 2 setae, 2 or 3 singly-inserted, superolateral setae, and lacking inferolateral setae; dactyl with inner row of bladelike spines, nail short. Posterior margin of segment 5 of second gnathopod swollen and covered with fine, hairlike setae. Coxal plate of gnathopod 2 small, subquadrate, with 2 marginal setae. Pereopod 7 about 55 percent long as body, slightly longer than pereopod 6, and longer than pereopod 5. Bases of pereopods 5, 6, and 7, 30 to 40 percent as long as corresponding propods. Coxal gills present on segments 2 through 6, absent on segment 7; pedicels rather narrow. Sternal processes absent.

Abdominal sideplates generally similar; posterior margins only slightly

convex, posterior corners defined by 1 seta each; plate 3 with 1 small spine or stiff seta near ventral margin. Pleopods 1 and 2 subequal in length, 3 shorter; inner rami slightly longer than outer; peduncles with 3 coupling hooks each, on inner, distoposterior margins. Uronites 1 and 2 with 2 dorsolateral spines each; uronite 3 with 4 dorsolateral spines, in groups of 2. Uropod 1 with inner and outer rami about equal in length, with 5 or 6 spines each; peduncle a bit longer than rami, with 9 or 10 spines. Uropod 2 with inner ramus slightly longer than outer, but about equal in length to peduncle, armed with 5 spines; outer ramus with 5 spines; peduncle with 3 spines. Uropod 3 rather prominent, about 15 percent long as body; outer ramus 1-segmented, slightly longer than inner and bearing more spines. Telson cleft two-thirds way to base; apical lobes with 3 spines each.

Female. Propod of gnathopod 1 proportionately smaller than in male, subrectangular; palmar margin short and bearing several tiny spines and 3 or 4 setae; posterior angle rounded, indistinct; posterior margin elongate, expanded distally, covered on inner margin with short, hairlike setae; lateral setae few in number, rather long; dactyl short, thick, with rather large nail. Segment 5 of first gnathopod slightly longer and broader than corresponding propod. Gnathopod 2 with propod proportionately smaller than second gnathopodal propod of male, rather long, subrectangular; palmar margin with double row of 3, unnotched, peglike spine teeth; posterior angle defined by 2 long setae; posterior margin long, gently tapering proximally, with 2 marginal sets of long setae; superolateral setae few, inferolateral setae absent; dactyl nail rather long. Segment 5 of second gnathopod with broadly expanded posterior margin covered with short, hairlike setae. Second coxal plate subovate, rather small, with 2 marginal setae. Brood plates small and narrow.

Remarks: Of the collections available, only the one from the type locality includes females with completely developed brood plates (*i.e.*, fringed with setae). One female (3.0 mm) from that sample was ovigerous, containing two large eggs in the pouch. Another egg was floating free in the sample container, and may also have belonged to this female.

Etymology: It is a pleasure to name this novel species in honor of its original collector, Dr. Gerald A. Cole of the Department of Zoology, Arizona State University, in recognition of his substantial contributions to our knowledge of freshwater crustaceans of North America.

Mexiweckelia particeps Holsinger new species
(Figs. 5–6)

Material examined: Holotype and five paratopotypes: unnamed, small spring in raised marsh at north tip of Sierra de San Marcos, 7.45 km south and 5.42 km west (Fig. 4), 12 August 1968, G. A. Cole. The holotype and three paratopotypes are deposited in the Smithsonian Insti-

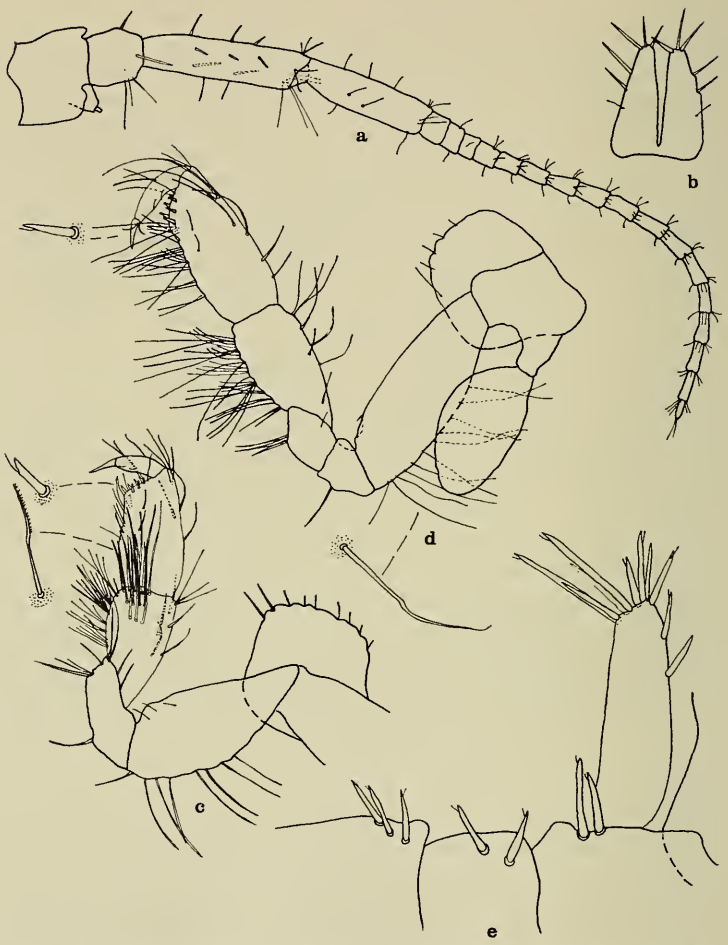

FIG. 5. *Mexiweckelia particeps* new species. Male paratype (5.50 mm): a, antenna 2; b, telson. Female paratype (5.00 mm): c, d, gnathopod 1 and 2; e, lateral view of uronites and telson.

tution, and slide mounts of two paratopotypes are retained in the collection of Holsinger.

Diagnosis: A small, interstitial species, readily distinguished from *Mexiweckelia colei* by its larger size; proportionately longer antennae; distinct, 1-segmented accessory flagellae on the first antennae; slightly more spines and setae on mouth parts; more slender fifth and sixth segments of gnathopods; more dorsolateral spines on uronites; more setae

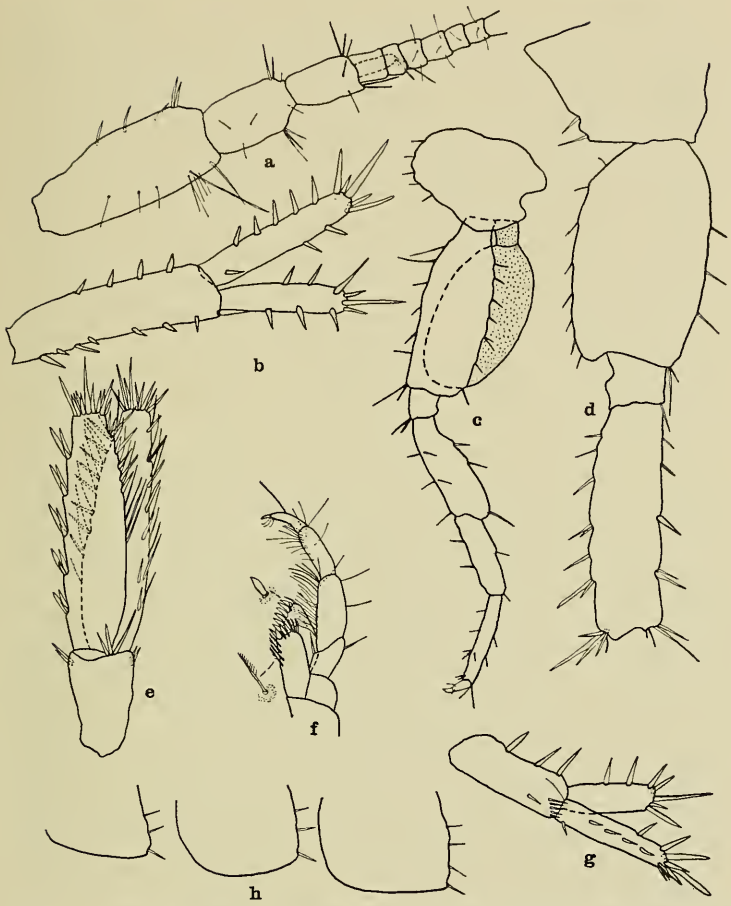

FIG. 6. *Mexiweckelia particeps* new species. Male paratype (5.50 mm): a, antenna 1; b, uropod 1; c, pereopod 4; d, upper part of pereopod 7. Female paratype (5.00 mm): e, uropod 3; f, maxilliped; g, uropod 2; h, abdominal sideplates.

on posterior margins of abdominal sideplates; proportionately longer third uropods; lateral spines on telson, and more deeply cleft telson. Largest male, 5.5 mm; largest female 5.0 mm.

Description: Male. Antenna 1 about 80 percent long as body, 15 to 20 percent longer than antenna 2; peduncular segments 1–3 progressively smaller, with few marginal spines and setae; primary flagellum with up to 40 segments; accessory flagellum 1-segmented; slender calceoli

on some primary flagellar segments. Antenna 2 with peduncular segment 4 slightly broader and longer than segment 5, with several marginal spines; flagellum with up to 17 segments. Mandibular palp absent; mandible otherwise well-developed; seta present on right molar, absent from left; spine row with 3 or 4 setose spines on right mandible, 5 or 6 setose spines on left. Maxilla 1 generally similar to that of *Mexiweckelia colei*, with regard to difference in apex of palp, but with 9 apical, serrated spines on outer plate and 7 plumose setae on margin of inner plate. Maxilla 2 with inner plate bearing oblique row of 11 long setae on inner margin. Maxilliped with palpal segments rather slender, segment 2 the longest; outer plate expanded medially, extending beyond first segment of palp and bearing 6 or 7 blunt-tipped spines sub-apically; inner plate subrectangular, with 3 or 4 thick spines and several thick setae apically, and 4 long, plumose setae on inner margin. Lower lip similar to that of *M. colei*.

Gnathopod 1 with subrectangular propod, slightly broader proximally than distally, palmar margin rather short, armed with double row of 5 peglike spine teeth; posterior angle well defined with single, large spine; posterior margin long, uneven, with single spine and several long setae; lateral setae few in number; dactyl nail long. Segment 5 of gnathopod 1 rather long, long as propod, inner margin with 3 sets long, thick setae, distally. Coxal plate of gnathopod 1 subrectangular, with 9 or 10 marginal setae. Gnathopod 2 with propod proportionately larger than first, rather narrow, subrectangular; palmar margin oblique, armed with double row of 6 or 7 unnotched, or unevenly (but not distally) notched, spine teeth; posterior angle defined by 3 peglike spine teeth and several long setae; posterior margin comparatively long, with 2 sets of long setae; lateral setae few in number, singly-inserted; dactyl nail rather long. Second coxal plate with 5 or 6 marginal setae. Pereopod 7 between 60 and 65 percent long as body, equal to, or slightly longer than, pereopod 6, longer than pereopod 5. Structure of pereopods generally similar to those of *M. colei*, except for presence of few more spines. Coxal gills present on segments 2 through 6, absent from 7; pedicels shorter and broader than in *M. colei*. Sternal process absent.

Abdominal sideplates 1 and 2 with stiff, posteromarginal setae, and plate 3 with 4 such setae; ventral margins without spines or stiff setae. Pleopods generally similar to those of *M. colei*, except that peduncles have 4 or 5 coupling hooks. Uronite 1 with 6 dorsolateral spines (in groups of 3); uronites 2 and 3 with 4 dorsolateral spines each (in pairs). Uropod 1 with outer ramus shorter than inner and peduncle, armed with 9 spines; inner ramus shorter than peduncle, armed with 12 to 13 spines; peduncle with 12 spines. Uropod 2 with outer ramus a little longer than inner and peduncle, armed with 11 spines; inner ramus with 7 spines; peduncle with 3 to 5 rather large spines on dorsal margin and 6 to 8 smaller ones in cluster on distal, outer margin. Uropod 3 prominent, 18 to 20 percent long as body; inner ramus often slightly longer than

outer, with an inner and outer marginal row of setae singly-inserted setae and spines; outer ramus with clusters of spines on lateral margin and a row of singly-inserted spines and setae on inner margin; both rami armed apically with numerous slender spines. Telson cleft nearly to base; apical lobes with 3 spines each, outer margins with 2 lateral spines each.

Females. Gnathopod 1 has propod palmar margin slightly shorter than male, armed with double row of 3, peglike spine teeth; posterior margin lacking spine. Propod palmar margin of gnathopod 2 slightly shorter than in male, armed with double row of 3 spine teeth; posterior angle defined by 1 spine; posterior margin with 3 or 4 sets of setae.

Remarks: Although the two largest females (5.0 mm each) in the sample appear well-developed, they are not ovigerous, and had small, non-setose, brood plates. This species is presently known from only the type locality, where the series of six specimens (1 male and 5 females) was collected along with three specimens of *Mexiweckelia colei*.

Etymology: The name, "*particeps*," is Latin, meaning comrade, partner, or sharer. The species is so named because of its syntopic association with *Mexiweckelia colei*.

Ecological considerations: All habitats from which *Mexiweckelia* has been collected are positioned near the lower *bajada* of Sierra de San Marcos (Fig. 4), in a zone of thermal springs which are markedly constant in physical and chemical conditions. For example, temperatures at the points of collection of the amphipods ranged from 30° to 33°, all had a *p*H of 7.2, and total alkalinities (expressed as calcium carbonate) were from 190 to 220 milligrams per liter (mg/l). The principal ions in such waters of the Cuatro Ciénegas basin are calcium and sulfate, each making up more than 50 percent of their respective groups (cations and anions) by weight. Other cations are arranged as follows: magnesium > sodium > potassium, and anions; carbonates > chlorides. Total dissolved solids in the spring sources usually range between 2.1 and 2.4 grams per liter. There is no residual acidity, and the water quickly attains *p*H 8.3 when aerated. Only one determination of dissolved oxygen concentration was made directly in a *Mexiweckelia* habitat, and this was about 3.3 mg/l. Other spring sources had comparable concentrations, ranging from 1.7 to 4.1 mg/l, often less than 50 percent of saturation. Turbidities are not detectable except when local rainfalls, which are infrequent, move surface waters into the springs, and this is only transitory (Minckley and Cole, 1968a, and unpublished data). Flow of water in places where *Mexiweckelia* was taken ranged from mere seepages of a few liters per minute, to about 12 cubic meters per minute at the outlet of Laguna Churince.

Almost all specimens of *Mexiweckelia* were taken in association with, or within, dark, soft, fine-grained or fibrous, detrital sediments, notwithstanding the size or morphometry of the overall habitat involved. In two instances, small seeps had water upwelling through such materials. The bottom was carefully stirred and seived to collect the animals, or was

vigorously stirred, causing the amphipods to become trapped in the surface film, and they were secured by hand, with forceps, or by fine-meshed seives. Two other habitats were the outlets of small springs, which emerged from tiny (10- to 30-centimeter) caves. The animals were far rarer there, but a few were taken from detrital sediments accumulated in and around roots of riparian plants. A third habitat was in a senescent, almost vegetation-filled pit-spring, or *pozo* (hole or pit) in local terms, about 2.5 m across and of unknown depth, where *Mexiweckelia colei* was abundant in soft, fibrous detritus accumulated beneath a floating sedge mat. All the preceding habitats lacked fishes, or other larger predatory animals (except a few naucorid hemipterans). *Mexiweckelia colei* was not uncommon, however, in organic sediments about the roots of aquatic and semiaquatic plants and along the shorelines, in two larger spring-pools (*laqunas*) that were abundantly occupied by a number of fish species. *Mexiweckelia particeps* was caught in one of the smaller seepage-springs described first. It was not recognized as distinct in the field, and details of habitat differences between the two sympatric amphipods, if such exist, are therefore unknown.

The small sizes, and transparency in life, of the species of *Mexiweckelia* (and some other subterranean crustaceans) make them especially difficult to collect, and their extreme fragility necessitates careful handling and preservation. Cole achieved considerable success in trapping less mobile crustaceans (principally cirolanid isopods) in jars buried with their mouths flush with the surface of bottom sediments in the mouths of springs, and also by placing "wads" of gauze in the spring sources. The last technique attracted some amphipods, many *Hyalella* and a few *Mexiweckelia*, and isopods, and should be tested further by using synthetic fibers that could be placed in springs for days or weeks, then re-checked periodically. The artificial substrate may be gently examined manually in the field, simply preserved *in toto* and returned to the laboratory, or the animals may be driven from it by judicious application of ethanol or some other substance in sublethal amounts, and then preserved.

Associates: The abundance of the ubiquitous *Hyalella* in many springs of the Cuatro Ciénegas basin also confuses the issue of collecting *Mexiweckelia*. This results from the physical presence of large numbers of animals, and also from some of the *Hyalella* being depigmented. Color variation of this amphipod is impressive, ranging from almost totally white, through the more typical grayish-tan or bluish, to almost golden. All the *Hyalella* have well-developed eyes, but depigmented individuals are closely linked to springs, interstices of travertines, detrital bottoms, or other quasi-subterranean habitats of the Cuatro Ciénegas area. The amphipod achieves its greatest abundance in closely-spaced vegetation of open waters of the basin. Another common crustacean of the head-springs, in or on detrital sediments, is the ostracod *Chlamydotheca*.

All four of the eyeless, locally endemic, isopod crustaceans known

from the Cuatro Ciénegas basin (Minckley, 1969) have been taken in close association with *Mexiweckelia*. The cirolanid species *Speocirolana thermydronis* Cole and Minckley (1966) is a relatively large, active form, widespread in open channels of springs and in the more loosely constituted travertines and detrital deposits (Minckley and Cole, 1968b). Two other cirolanids, *Sphaerolana interstitialis* Cole and Minckley and *S. affinis* Cole and Minckley (1970), are perhaps more characteristic of the *Mexiweckelia* habitat, often living in identical, fibrous, detrital sediments along the margins of spring runs and in the springs themselves. The fourth isopod is the new, undescribed genus of the asellid subfamily Stenasellinae, which is rare in collections. Three of the nine known specimens of this species occurred along with *Mexiweckelia* (Cole and Minckley, unpublished data).

The molluscan fauna includes a number of species which are closely associated with groundwater habitats, or are essentially subterranean (Taylor, 1966, and unpublished). Forms notably associated with the new amphipods include undescribed species of *Durangonella* and *Haufenia*, and *Paludiscala caramba* Taylor, all of the family Hydrobiidae.

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